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THE FORMS OF *JUPITER'S* SATELLITES.

By J. M. Schaeberle and W. W. Campbell.

While we were engaged in observing the markings on the third satellite of *Jupiter* with the 36-inch equatorial, in 1891, August, September and October, we noticed that the first satellite was not round. Careful observations of all the satellites on several nights have led us to conclude that the first satellite of *Jupiter* is ellipsoidal, that its longest axis is directed towards the centre of *Jupiter*, and that the other satellites appear to be spherical. (See *Astronomical Journal*, no. 247.) The results of the observations on the several nights are given below.

1891, Sept. 6. Seeing very fine. [The spiral or double-ring structure of the nebula in *Draco*, G. C. 4373, shown beautifully under all powers up to 3000.] While waiting for eclipse (reappearance) of satellite III, it was seen that I was elongated in the position angle 70°–250°, in the ratio 5:4. I, II and IV were successively brought to the same collimation axis without changing the focus, using all powers up to 3000, but 2000 was used to best advantage. I was decidedly elliptical under all tests; II and IV were round. After the reappearance of III, the observations were repeated: I elongated; II, III and IV round.

At the extremities of the major axis of I were bright regions which probably caused a part of the apparent elongation, but cannot account for it all. Later, it was noticed that the position angle 70°–250° was equivalent to the longer axis pointing towards *Jupiter's* centre.

1891, Sept. 16. Seeing, weight 3.

The highest power used was 1000. I was decidedly elongated, probably 5:4, in a direction parallel to *Jupiter's* equator, the end towards *Jupiter* being very bright. II appeared very slightly elongated in position angle 45°–225° with reference to *Jupiter's* polar axis, probably owing to the very bright region at the southern end of the major axis. III was round, but a very bright region on the northeast limb gave it the appearance of being elongated, when the seeing was poor, in the direction 30°–210° with reference to *Jupiter's* polar axis. This probably accounts

for SECCHI's observed ellipticity of this satellite (see *Astr. Nach.*, no. 1017, pp. 135–142). IV was round; the end towards *Jupiter* bright.

1891, Sept. 20. Seeing, weight 2.

While I was in transit, near egress, it appeared round, or very nearly so. Its shadow was likewise round or only very slightly elongated the whole time. Powers greater than 700 could not be used on account of poor seeing. After the egress of I it was certainly elongated, though not so much as had been observed before, and there were bright regions at its preceding and following ends. II was either round or elongated only very slightly as before. III and IV were round.

1891, Sept. 26. Seeing, weight 4.

I was certainly elongated in direction of *Jupiter's* equator, but less than when it was observed near quadrature. The bright regions on I were not at all prominent. II was either perfectly round, or very slightly elongated nearly at right angles to *Jupiter's* equator. III and IV were round. The northeast polar cap on III was scarcely visible. Powers 700 and 1000. [W. W. C. alone.]

1891, Sept. 27. Seeing, weight 3.

Before and after transit, I was certainly elongated, apparently not so much as when seen near quadrature. During the visible part of its transit it was continually elongated in the direction of *Jupiter's* equator. When nearest the centre, it was almost round. At $10^h\,27^m$ P. s. t., just before egress, it was elongated 2:1, and two condensations of light in it gave it the appearance of being double. The shadow of I was elongated 3:2 just after ingress, and when nearest the centre was only very slightly elongated. II was very slightly elongated nearly at right angles to *Jupiter's* equator. III and IV were round.

1891, Oct. 4. Seeing, weight 3.

Before and after the transit of I, it was certainly elongated. During the transit the elongations of I and its shadow varied from 1½:1 or even 1¾:1, just after ingress, to nearly round when they were nearest the centre. II appeared elongated nearly 5:4 in the direction 15°–195° with reference to *Jupiter's* polar axis, but a very bright region was observed at its southern extremity. III and IV were round.

1891, Oct. 17. Seeing, weights 3 and 4.

When the seeing was best, I was elongated; its equatorial regions were fairly bright. II was practically round, bright southern region. III and IV were round. The southeast limb of III was bright. [W. W. C. alone.]

1891, Oct. 18. Seeing, weight 2.

I very noticeably elongated; the equatorial extremities were bright. II was very slightly elongated, the south limb was very bright, and the north limb was bright. III round, but in poor seeing it appeared elongated in direction 25°–205° with reference to *Jupiter's* axis, probably owing to its bright southeast limb. IV was round. [W. W. C. alone.]

1891, Oct. 23. Seeing, weights 3 and 4.

Satellite I clearly elongated in good seeing, power 1000, the preceding and following limbs very bright. II apparently elongated at times in position angle 30° with reference to *Jupiter's* axis, but perfectly round in best seeing. III apparently elongated in position angle 35° with reference to *Jupiter's* axis, owing to very bright northeast limb and bright southwest limb, but perfectly round in best seeing. IV round. Shadow of IV nearly round, with penumbra. [W. W. C. alone.]

1891, Oct. 24. Seeing, weights 2, 3 and 4.

I elongated 5:4. II in transit near egress, round; its shadow slightly elongated in *Jupiter's* equator, with penumbra. III and IV round. [W. W. C. alone.]

It is evident from these observations that the apparent forms of the satellites are largely affected by the bright regions on portions of their limbs, especially when the seeing is poor. Taking everything into consideration we are convinced that Satellite I is actually elongated in a direction nearly parallel to *Jupiter's* equator, the ratio of the axes lying between 10:9 and 5:4, probably very near the last limit; and that the other satellites are practically round.

The elongation of I confirms the view, afforded by some photometric measurements, that its periods of rotation and revolution are equal. Other things being equal, the maximum bright ness due to the ellipsoidal form would occur when the satellite is in quadrature.

From the observations of I and its shadow during transits given above (see also *Publ.* A. S. P., no. 17: p. 265, J. E. K.; p. 267, J. M. S.; p. 268, E. S. H.; p. 269, E. S. H. Also, *Astr. Nach.*, nos. 2995 and 3051, E. E. B.), it is plain that various phenomena can be expected. This is probably due to the great variety of backgrounds which *Jupiter's* surface affords; to the effect of *Jupiter's* atmosphere; and, possibly, to that of the satellite.

PATH OF A SHOOTING STAR.

By Torvald Köhl.

Among the corresponding observations on Perseïds made in Denmark this year there is one of special interest to which I beg to direct attention. The meteor appeared on the 11th of August at $10^h\ 34^m\ 29^s$ (mean time of Copenhagen) and was observed in *Copenhagen* and also in *Odder*, situated in 2° 25′ w. long. from Copenhagen, 55° 58′ n. lat.

The lines drawn through the beginning and the end-points of the apparent path almost exactly touched the position [17°, 6° 40′] where the eastern station (Copenhagen) was to be seen from the western (Odder), and with corrected positions

	Beginning.	End.
Odder	312° + 29°	290° + 14°
Copenhagen	234° + 26°	236° + 12°

The computation was made in two different ways, which gave the following results:

Method.	Beginning.			End.		
	h	λ	φ	h	λ	φ
Construction . .	95	2° 0′w.	55° 34′n.	90	2° 36′w.	55° 15′n.
Calculation . . .	95	2° 0′w.	55° 34′n.	93	2° 36′w.	55° 14′n.

The shooting star appeared in a height of 95 kilometers above the northern coast of the Danish island Fyn and disappeared 91.5 kilometers above a place near Assens on the same Island. In about one second this meteor had passed 52 kilometers away,